DOCUMENT RESUME

ED 253 261 JC 840 332

AUTHOR Renz, Peter L.
TITLE Style versus Content: Forces Shaping the Evolution of Textbooks and Courseware.
PUB DATE Jul 84
NOTE 18p.; Paper presented at the Sloan Foundation Conference on New Directions in Two-Year College Mathematics (Atherton, CA, July 11-14, 1984).
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Curriculum; Community Colleges; *Course Content; *Curriculum Development; Economic Factors; *Educational Change; *Mathematics Curriculum; Publishing Industry; *Textbook Preparation; *Textbook Publication; Textbooks; Two Year Colleges

ABSTRACT

Written from the perspective of a textbook editor, this paper reviews the limitations on curricular reform in mathematics. In the first section, an argument is presented that the style and manner of the presentation of educational materials are more important than the content presented. This section also raises objections to the current push to make discrete mathematics, rather than continuous mathematics, central to the college curriculum. In the next section, course development is compared to the evolution of a new species, and the role of the publishing industry in anticipating and shaping curricular developments is discussed. Next, the paper explains why large technical texts for large markets show little variability, indicating that large scale innovative textbook publishing only becomes attractive to publishers when much of the costs are carried by others. Finally, the paper discusses the role of computer technology in the development of new curricular material, foreseeing an unprecedented flowering of innovative and experimental course materials and arguing that the style and execution of the materials produced will have a greater effect on curriculum development than the exact content of the materials. (LAL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

P. L. Renz

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☒ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED253261

JC 840 332

STYLE VERSUS CONTENT:
Forces shaping the evolution of textbooks and courseware

by

Peter L. Renz
Editor, W. H. Freeman and Company
41 Madison Avenue, New York, NY 10010
and
Division of Sciences
Bard College, Annandale-on-Hudson, NY 12504

Summary.

To focus on matters of content to the exclusion of matters of style and execution in proposing new curricula is to lose sight of the essentially evolutionary nature of the development of courses and course materials. Strong selective pressures work against large-scale changes in large courses. These constraints are partly the result of inertia and of existing requirements outside of the mathematics curriculum, and they are partly economic in nature, affecting what will and what will not be economic to publish. This is a review of these limitations or curricular reform and the conclusion is that the success of such changes is more dependent on the style and execution of the materials produced than on the exact content of those materials.

Paper presented at the Sloan Foundation Conference on New Directions in Two-Year College Mathematics, Atherton, California, July 11-14, 1985.

STYLE AND CONTENT

What is it that makes a truely successful course or text? Is it more a matter of content or of the manner in which the material is presented? The answer depends upon one's objectives and one's point of view. On balance I say that style and manner of presentation are more important than content. In particular, the matter of discrete versus continuous mathematics seems a side issue. The main issue should be how to achieve success in the classroom, and this issue depends upon the details of the teacher's interaction with his or her students. Where texts and courseware are concerned, success depends upon the ability of authors to reach out to students with apt and compelling arguments and with clear and evocative images. Success in education also depends upon students and teachers having clearly formulated goals, both overall and in detail, and ways to judge the level of success in achieving these goals.

One might properly be alarmed or horrified by the content, or even the methods, of R. L. Moore's topology classes. One might even disapprove of the narrow focus that comes with the use of pure discovery-learning, but Moore's successes and those of his students are legendary. This shows that style can triumph over content. I venture that there are no examples of the triumph of content over style. If the presentation is sufficiently bad the students are lost.

The debate concerning whether discrete or continuous mathematics should be central to the curriculum will simply pass away. Change will come by evolutionary forces. Those who heralded the discrete revolution will be enshrined as saints by some and cursed as devils by others. But the changes that are made will be the work of the foot soldiers, teachers in the trenches who

are subject to unpleasantness and risk as they work up new course material or help purge the errors and infelicities of other's course notes. These teachers are my heroes, along with their striving and suffering students.

The discrete revolution is being oversold. I raise three objections to it as a cure-all. First, the discrete/continous dichotomy is not as sharp as it is pictured. This is borne out by many sources, but I have been particularly impressed by the depth and breadth of the arguments made in response to Anthony Ralston's position piece to appear in the November 1984 issue of The College Mathematics Journal. The responses by James P. Crawford, Daniel J. Kleitman, Peter D. Lax, Saunders MacLane, Daniel H. Wagner, and R. L. Woodriff emphasize the central importance of the insights gained from continuous mathematics. Insights of great use even for the study of discrete systems. Such respondents as William F. Lucas and R. W. Hamming emphasized the importance for modern applications of both discrete and continuous mathematics--and these respondents are very strong proponents of discrete mathematics.

Second, the importance of manner of presentation of the material has been largely pushed aside in the struggle over what is to be presented. My thoughts on this have been sharpened by seeing how clearly this issue has been set forth by the responses to Fred Roberts's position piece in the cited issue of the College Mathematics Journal on the role of discrete mathematics in the college curriculum. Of the six responses that I have been in draft, four see the main issues in the introductory college mathematics curriculum as being pedogogical (style and manner of presentation) rather than content. I direct your attention to the responses by John Mason, Patrick W. Thompson, and William Ellis, Jr. on this.

Third, until strong and successful models for these new discrete mathematics courses are available, we are unable to even see clearly what is being proposed. The reason is that discrete mathematics is a very broad area and it is full of very difficult and demanding material (try to master Ramsey theory, for example). Until a practical course has been plotted through these seas the proposal that this voyage be undertaken by teachers in large numbers is as irresponsible as it would have been to propose a general assault on the problem of sailing west from Europe to India before Columbus, Magellan, et al.

For these reasons and for others set out below, I believe that we should put the noise of debate behind us and get on to the real business at hand: making the experiments that will give us new courses for this new curriculum and make safe the voyage to this new land.

My plea is for evolution not revolution for two reasons: first, evolution is the way things actually happen and second, evolution is a continuing process. Change is essential if mathematics is to be a vital subject.

DEVELOPING NEW COURSES

The development of new courses from their conception is similar in some respects to the emergence of a new species. Ideas serve as a sort of modifable genetic code guiding the development of the course, but these ideas are not enough. There must be the proper local environment to allow realization of the idea; and, if anything is to come of this all, the idea and its realization must be able to catch on elsewhere.

The proposal to restructure the college curriculum so that discrete mathematics is taught early and calculus comes later is like proposing to insert a new gene into the chromosomes controlling the cells of the curricular organism. I believe that a cautious approach should be taken to such experiments lest one produce monstrosities.

Natural mutations yield many variant forms, but those that represent substantial variations of large creatures naturally abort and never live to see the light of day. Successful variants begin small. Mammals first appeared as a few small creatures and by evolution, with its general tendancy toward larger forms (Cope's rule) and greater diversity and specialization gave us the full range of mammalian life that we see today. For creatures the size of elephants, we see little in the way of rapid change. (See McMahon and Bonner [1983] for the biology.) So it should be with curricular change. The new mathematics experiment illustrates the disastrous potential of large scale, rapid, and radical change imposed from without.

The wonderous diversity of life arises from selective pressures acting on random mutations. We may best understand the dominant types of texts and courses as arising by a similar evolution under competitive pressures. This viewpoint explains much, even though it ignores the distinction between the wholly random character of mutation in biology (prior to the invention of genetic engineering) and the purposive nature of curricular reform, and course and textbook planning.

As an editor, it has been my task to anticipate curricular developments and to select or develop texts that will establish substantial positions in both existing and new markets. From the editor's point of view, it is clear that there are more sound, even exciting, possibilities than there can be economic niches in the market. Again from the same point of view, these possibilities, whether put

forth in book proposals, class notes, comprehensive plans for curricular reform, or in discussions, are just so many hopeful mutations whose potential is yet to be proved. This presumes that we know what success means in this context. For publishers, success is a commercial matter--sales great enough to cover costs and give a pleasing return that can be used to finance new projects, provide increased compensation for employees and increased returns for investors, and meet all the other needs of a prosperous enterprise. What publishers seek is overall success, that is, success of the enterprise as a whole. This is by no means inconsistent with taking on high-risk projects or occasional projects primarily for the good of the discipline and as a sign of the house's commitment in a given area.

Academics and publishers often do not understand one another simply becuase they do not understand each other's goals or their separate conditions of life including the constraints on achieving their separate goals. Here I will give the picture as seen by a publisher. I will focus on the numbers, because they are easy to understand and they are the main contraints affecting all publishers almost equally. moreover, the numbers will show where the best opportunities for curricular reform life, insofar as realizing those opportunities depends on the publication of new course materials.

WHY LARGE TEXTS FOR LARGE MARKETS SHOW LITTLE VARIABILITY:
The effects of scale

Large technical texts with many diagrams are expensive projects even before the first copy is printed. Typesetting, art, page make-up, including allowances for all proof and corrections for a two color, 8 X 10 inch, standard calculus book of about 1200 pages would cost about $235,000 in 1984. To these

costs we add editorial expenses including reviewing, checking of answers and solutions, travel, grants to the author for manuscript preparation, and in-house editing and development. I estimate these at about $50,000. Finally, for a complete package one must add the cost of supplements (Solutions Manual, Student Study Guide, and so on), a small publishing program itself. These might run to $40,000.

How does such a book look as a business proposition? The publisher must face the fact that competition, including the new and used book market, takes a very heavy toll on sales in the larger markets (annual decreases in sales usually exceed 20% and may exceed 30%). Furthermore, substantial sales for mainline books can seldom be sustained much beyond the fifth year after publication. Thus, a book that sells 10,000 copies in this sort of market in its best year might be expected to sell 30,000 to 40,000 copies altogether before it fades completely. Such sales would prove disastrous for the publisher. Here are the numbers for sales of 35,000 copies over 5 years at a nominal list price of $40.

Profit (loss) on sale of 35,000 copies of a calculus book

List price $40.00 Net price $32.00 Net receipts $1,120,000

less printing, paper, & binding costs	$210,000	(@$6 per book)
less royalties	168,000	(@15% of net)
less operating overhead	560,000	
less investment	335,000	
Net loss	($153,000)	

Here I have allowed 50% of net receipts for all operating costs under the assumption that all miscellaneous costs, including those representing the time value of money are expensed for the publishing house as a whole. This allowance

is perhaps high, but it is close to actual costs, and it is not clear that this allowance could be reduced below 40% for the operations of any sizable publishing company. I have assumed that inflationary and interest effects generally cancel each other.

For the publishing house to earn a profit of 10% of net before taxes (a modest rate) with this model, it needs to sell about 170,000 copies. Again allowing 5 years for this would require selling about 50,000 copies in the best year. Few books do this well (Anton, Swokowski, and Thomas/Finney are among the few). However, success of this magnitude allows economies of scale. In particular, it floats a large operation (promotion, sales, etc.) and it positions a company well for revisions, which are generally less expensive (art can be reused, etc.) and more certain in pay-off.

Nevertheless, this analysis shows why in freshman calculus (500,000+ students per year) and other large markets competition produces uniformity. No publisher can afford to produce a full-scale calculus book that is so different or so specialized that it is not a serious contender for mainline courses.

In recent times no slim alternative book has swept the market (say by taking as much as 5% of the market) and the costs of launching a full scale calculus book can't be comfortably borne by sales of less than 170,000 copies (representing 10% market penetration) and such sales represent about the largest cut of the pie that one can look for today. The result is that calculus books must compete mostly through minor variations and improvements. The dominant books expand by spawning minor variants that act to cut down the profitability of the market and thus squeeze out competitors (consider Swokowski's Alternative Edition).

Here we see Hotelling's law of duopoly at work. Large competitiors compete by matching each other's product lines and going for the center of the market. Consider Ford and General Motors, Time and Newsweek . This is convergent evolution at work in an area where the economies of scale allow only a few variants to survive. The freshman calculus text is an elephant of texts and the economy simply can't support very many types of elephants. Economic forces prevent substantial innovations in courses of this size.

CURRICULAR FORCES LEADING TO UNIFORMITY IN LARGE COURSES

Large courses are taught by teams and the direction of such courses is determined by group choices. Committees work by averaging and tend to conservative decisions. Morevoer, large courses in the sciences and mathematics usually have a strong service function, both for higher level courses in the same discipline and for courses in other disciplines. The client departments for such students expect a uniform and dependable product and these expectations strongly limit the possibilities for innovation or change.

Redirection of the introductory curriculum requires agreement on new standards. Until such standards prove themselves workable in the classroom and are found more effective for student's future work and for the client departments, prudent departments will not rush to institute new courses and prudent publishers will not rush to publish large or lavish books for such courses. Indeed, even mild deviations that are untested may be viewed with suspicion.

COMMERCIALLY ATTRACTIVE INNOVATIONS

Today's calculus book evolved from smaller ancestors by gradual additions and adaptations. If the present type did not exist for us to imitate, no author would invent it as an entirity as it is today and no publisher would invest in it. However, new types of texts are produced every year. Many are eliminated by market forces. The quite considerable costs and development and publication are borne by the authors, their institutions, and the publisher. As an editor, I have seen that many serious efforts are never pushed to completion by the authors while others are found by reviewers to be unsuited to their intended markets and do not see the light of day. Each of the following examples was innovative and commerically attractive. They run from small projects to immense ones, and they illustrate what qualities innovative projects must have if they are to be commerically acceptable.

Smaller projects allow more attractive opportunities for innovative publishing. For example, Loren Larson's ALGEBRA AND TRIGONOMETRY REFRESSER FOR CALCULUS STUDENTS was based on a successful supplement in use at the author's school. Neither the idea of a review book nor the concepts and skills to be reviewed (content) were novel but the way in which the review was set out was compelling and the care in bringing it together let one see that this would work (style). This project was attractive in its existing form to reviewers at other schools. Further, it made sense to print this informal book from author-supplied copy, typed after the publisher's editing and work on the art and design. The result was a project requiring an investment about equal to about 0.05 times that of the standard calculus book described earlier.

To break even with this sort of small project, one need only sell 3,000 copies. The sales of this book have exceeded 30,000 copies in fives years and it has achieved a percentage return on net beyond that that could ever be

expected in a standard calculus book.

Other examples of similar success of small projects based on successful local texts, each of which meet a need not met by existing texts, are QUICK CALCULUS by Dan Klepner and Norman Ramsey (J. Wiley and Sons) and OPERATIONS RESEARCH FOR IMMEDIATE APPLICATION: A QUICK AND DIRTY GUIDE by Robert E. Woolsey and Huntington S. Swanson (Harper and Row). I would argue that the success of both of these books is more a function of their style and execution than of their content.

A larger scale innovative project is David Moore's STATISTICS: CONCEPTS AND CONTROVERSIES (W. H. Freeman and Company), again based on a successful course at the author's school and proven attractive to those experimenting with new types of statistics courses elsewhere. This project represents an investment equal to about 0.10 times that of our standard calculus book and requires sales of roughly 10,000 copies to break even. To achieve a 10% return on net with this sort of project sales of 20,000 copies are needed, roughly 0.10 times those required for our standard calculus text. Larger still and equally successful is the innovative statistics book by David Dreedman, Robert Pisani, and Roger Purves (W. W. Norton). This text was develcped and class tested over many years at Berkeley. It is style and execution not content alone that makes these books successful.

More pertinent to the discrete mathematics debate is MATHEMATICAL STRUCTURES FOR COMPUTER SCIENCE by Judith Gersting (W. H. Freeman and Company). Again this text arose from an existing successful course at the author's school. Here the target was the ACM's proposed course on discrete mathematics. The books cited earlier in this section were innovative in their goals; this is not the case for Gertsting. This course existed

elsewhere, enrollments were rising, and the author was unsatisfied with the available texts. It was not a matter of what the available texts set out to do (content) but rather how they did it (style). Gersting's course notes were polished by over three years of class testing before the book came out. The material was extensively reviewed by other teachers to ensure that the local success could be generalized. The result is a text that requires an investment not much above 0.10 times that of our standard calculus book and that shows a profit of more than 10% of net receipts with sales of less than 10,000 copies (that is about 0.07 times the sales required for equal profit from a calculus book). Moreover, sales of existing books indicated that conservatively one could expect to sell 5,000 copies per year if successful (actual sales have been about twice this high). This was pleasing in prospect and rewarding in retrospect. This book's revisions will face a more competitive market and give author and publisher smaller slices of a much larger pie.

W. H. Freeman and Company has published several books that set new patterns for what later came to be known as liberal arts mathematics, books by Sherman Stein (1963), by Harold Jacobs (1970), and by Bonnie Averbach and Orin Chein (1980).

With these books matters of content and style are inextricably interwoven, but each would have vanished without trace had it not been for superb execution of the projects. Each of these books was based on a successful working course and each stood the test of critical reviews before publication, two criteria that every innovative text should meet. Each has proved successful in the classrooms of other teachers after publication. Each offered a fresh point of view and a clear alternative for adopters. Each seemed a sensible commercial gamble, although declining enrollments in this course in recent

years together with a proliferation of available texts have made this a difficult market in the 1980s.

Each of these books requires a prepress investment roughly 0.25 times that required for our standard calculus book. For the two earlier books, I estimate that that investment would be fully recovered with the sale of 20,000 to 30,000 copies; whereas, for the most recent book, the break even point for sales lies above 37,500 copies and had not yet been reached in 1984. Compared to a calculus book the investment in about a quarter and the sales requirement to break even is about a seventh. This is a more appealing sort of gamble. The profit as a portion of net receipts lies in the 10 to 15% range for the fully mature older books. This relatively low rate of return comes from competitive forces. Long-term survival drives companies to offer the best product they can at a price low enough to keep the competition down. The spread between the marginal cost of printing, paper, and binding and gross receipts is smaller for books that have many competitors than it is for those that have few. This is one reason why more advanced books are more expensive; the relative size of the markets is another.

Large scale innovative textbook publishing is so risky that it only becomes attractive when much of the costs are carried by others. The committment of the professional community and of the government to The New Mathematics and to Chem Study carried forward these two innovations. I cannot cite any figures for The New Mathematics, but I can cite some for the initial Chem Study materials published by W. H. Freeman and Company in 1965. The rate of return on net sales has been very modest but the net receipts over nineteen years have exceeded eight million dollars and the investment was low. This chemistry reform project was meticulously developed and backed by the full faith and credit of the community of chemists and the government.

The terms of the arrangement allowing W. H. Freeman and Company to bring out this material forbade the Company from revising the original Chem Study material and hence from using its position to gain an unfair advantage once the new curriculum was established. It seems likely that the greatest rewards in this area were reaped by other publishers who profited by following the path broken by Chem Study and made improvements on the prototype published by Freeman.

NEW CURRICULAR MATERIAL AT THE DAWN OF THE AGE OF COMPUTERS

While the debate on continuous versus discrete mathematics continues, computer technology is creating a new environment. Students flock to existing discrete mathematics courses at the sophomore/junior level. These courses are part of the recommended curriculum of the ACM and they meet, in part, real needs for computer science departments. How some of this material can be worked into other courses remains to be seen. I would hope that the portions of it that are calculus related (generating functions, expectations, formal expansions, analysis of certain algorithms, etc.) will be showing up with more emphasis in introductory calculus.

Computer technology in the form of TEX, TROF, EQN, and other typesetting packages combined with powerful word processing programs and graphics packages could enable departments to develop far more polished preliminary editions of experimental texts. This may allow new books to be produced at substantial savings. The result is likely to be an unprecedented flowering of innovative and experimental course materials. The disadvantage will be that this will increase the amount of course material to be sorted out by the marketplace. The publisher plays an important role in sorting out projects and helping to improve them. As the means of production move more into the author's hands, this role will be reduced.

The main issue is not whether or not there will be more discrete mathematics in the curriculum, but how the detailed matters will be settled: What discrete-related material will come to receive more emphasis in existing courses, how new discrete courses will come to be organized, and over all, how compelling a mathematics curriculum can be devised and put into effect. The realization of any change is bound by economic constraints, some of which are outlined here. From my view it is style and execution that are of central importance for, as an editor, my job is to find the best author and to help that author produce the best course materials. In this context the content is almost a given and the differences in execution mark the difference between success and disaster. Thus the details of style and execution predominate for me, and I represent the editorial decision point. Whatever program is devised must at some point pass some form of editorial judgment. Here you have outlined the finanical constraints on such judgments.

The financial contraints are simply the conditions of life for publishers. How do publishers determine what projects are likely to meet their needs? I have suggested some of the criteria, but I have left out others that are obvious and extremely important. Is the project exciting? Is the conception and organization compelling? Is it clear to those within the company and to reviewers that the author has a real contribution to make? Can the virtues of the product be made evident to your intended audience? This is needed for reasonable sales. We are dealing with course materials so it is natural for potential publishers and for potential adopters to ask for proof of success in the classroom. The questions in this area are: Has the material been tested? Does the material work in the classroom? Does it appeal to other teachers? Finally we come to the economic questions: Is there an

existing or prospective market large enough to make the project economically feasible? True, the content is part of all of this evaluation, but success or failure of a book is not usually a matter of content--content is too obvious a matter. Success comes to authors with a gift for exposition, who can give the attention to detail that makes a book work for the author, the author's students, and for others.

The computer age will bring us new ways to produce books and new ways to put together instructional materials (courseware). These developments bring the author closer to the role of compositor and allow the author to move into a realm previously the province of the publisher. This has the potential of greatly reducing the publisher's cost of new teaching material and thus allowing for less costly innovation. This means that the real costs of creating and sorting out new materials will fall more on the authors (who will collectively produce greater quantities of new materials for limited markets and the result must be a lower average return) and on the users (who will be confronted by a larger selection of less carefully tested products). These developments seem inescapable consequences of present trends.

As these new courses, texts, and other materials are developed, the content will largely be determined by the perception of student needs, but successful courses will always depend critically on the style and presentation of the teacher in the classroom and of the authors of the materials used. Successful teaching is done in detail, not by choice of content and large-scale strategy.

REFERENCES

Crawford, James P. 1984. Calculus is not an indescretion. Mathematics Journal, November 1984 (in press).

Hamming, R. W. 1984. Calculus and discrete mathematics. Mathematics Journal, November 1984 (in press).

Kleitman, Daniel J. 1984. Response to Anthony Ralston's position. Mathematics Journal, November 1984 (in press).

Lax, Peter D. 1984. In praise of calculus. Mathematics Journal, November 1984 (in press).

Lucas, William F. 1984. Discrete mathematics courses have constituents besides computer scientists. Mathematics Journal, November 1984 (in press).

MacLane, Saunders. 1984. Calculus is a discipline. Mathematics Journal, November 1984 (in press).

McMahon, Thomas A., and Bonner, John T. 1983. On Size and Life. Scientific American Books.

Wagner, Daniel H. 1984. Calculus versus discrete Mathematics in OR applications. Mathematics Journal, November 1984 (in press).

ERIC Clearinghouse for Junior Colleges
8118 Math-Sciences Building
University of California
Los Angeles, California 90024

MAR 22 1985